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EXAMINER

PARENDO, KEVIN A

ART UNIT

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2823

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/585,994	KOBAYASHI ET AL.	
	Examiner	Art Unit	
	Kevin Parendo	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 October 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-12 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-12 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>7/13/06, 9/29/06, 10/11/06</u> | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of claims 1-8 in the reply filed on 10/16/08 is acknowledged. However, upon additional review, the examiner notes that since this case is a national stage application of a PCT, filed under 35 U.S.C. 371, the restriction requirement should be made with the "unity of invention" standard rather than the "independent or distinct" standard (see MPEP 1893.03(d)). Thus, the previous restriction is withdrawn.

Drawings

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: S1, S2 (as discussed in paragraph 19). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

3. Claim(s) 2, 7, and 8 is/are objected to because it/they contain(s) the limitation "a plasma" on line 3. This limitation has been claimed previously to this instance and thus lacks proper antecedent basis. To avoid any ambiguity, it is recommended to delete this limitation.

4. Claim(s) 3 is/are objected to because it/they contain(s) the limitation "a plasma" on lines 4-5 and the limitation "a plasma" on line 7. This limitation has been claimed previously to this instance and thus lacks proper antecedent basis. To avoid any ambiguity, it is recommended to amend the limitation on lines 4-5 to "a second plasma" and the limitation on line 7 to "a third plasma".

5. Claim(s) 3 is/are objected to because it/they contain(s) the limitation "a/an nitrogen-added silicon carbide film" on lines 6-7. This limitation has been claimed previously to this instance and thus lacks proper antecedent basis. To avoid any ambiguity, the word "a/an" should be changed to "the". Appropriate correction is required.

6. Claim(s) 4 is/are objected to because it/they contain(s) the limitation "a/an nitrogen-added silicon carbide film" on lines 7-8. This limitation has been claimed

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previously to this instance and thus lacks proper antecedent basis. To avoid any ambiguity, the word "a/an" should be changed to "the". Appropriate correction is required.

7. Claim(s) 4 is/are objected to because it/they contain(s) the limitation "a plasma" on lines 4-5 and the limitation "a plasma" on line 8. This limitation has been claimed previously to this instance and thus lacks proper antecedent basis. To avoid any ambiguity, it is recommended to amend the limitation on lines 4-5 to "a second plasma" and the limitation on line 8 to "a third plasma".

8. Claim(s) 5 is/are objected to because it/they contain(s) the limitation "a hardmask" on lines 3 and 6. This limitation has been claimed previously to this instance and thus lacks proper antecedent basis. To avoid any ambiguity, it is recommended to amend the limitation in both instances to "the hardmask".

9. Claim(s) 5 is/are objected to because it/they contain(s) the limitation "a specific pattern" on line 4 and the limitation "a pattern" on line 6. The second of these lacks proper antecedent basis. It is recommended to amend the first limitation to "a first pattern", and the second limitation to "a second pattern". Further, the limitation "to that" can be ambiguous, so for clarity, it is recommended to amend the limitation "corresponding to that of the resist film" to "corresponding to the first pattern".

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10. Claim(s) 5 is/are objected to because it/they contain(s) the limitation "a plasma" on line 5 and the limitation "a plasma" on line 8. This limitation has been claimed previously to this instance and thus lacks proper antecedent basis. To avoid any ambiguity, it is recommended to amend the limitation on line 5 to "a second plasma" and the limitation on line 8 to "a third plasma".

11. Claim(s) 7 is/are objected to because it/they contain(s) the limitation "active species" on line 2 that should be amended to "the active species".

12. Claim(s) 8 is/are objected to because it/they contain(s) the limitation "active species" on line 2 that should be amended to "the active species".

13. Claim(s) 10 is/are objected to because it/they contain(s) the limitation "first means" on line 3 that should be amended to "a first means".

14. Claim(s) 10 is/are objected to because it/they contain(s) the limitation "second means" on line 6 that should be amended to "a second means".

15. Claim(s) 11 is/are objected to because it/they contain(s) the limitation "first means" on line 3 that should be amended to "a first means".

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16. Claim(s) 11 is/are objected to because it/they contain(s) the limitation "the gas" on lines 8 and 11. The second of these lacks proper antecedent basis, and both are ambiguous due to the "first" and "second" "process gases". Thus, it is recommended to amend the first of these to "the first process gas" and the second to "the second process gas".

17. Claim(s) 11 is/are objected to because it/they contain(s) the limitation "the flow rate" on line 11. This limitation has been claimed previously on line 8 and thus lacks proper antecedent basis. It is recommended to amend this limitation to "a second flow rate".

18. Claim(s) 11 is/are objected to because it/they contain(s) the limitation "second means" on line 12 that should be amended to "a second means".

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

19. Claim 6 is rejected under 35 U.S.C. 102(b) as being anticipated by Endo (US 6,429,518 B1).

Re claim 6, Endo discloses a manufacturing method of a semiconductor device, comprising the steps of:

- depositing on a substrate (**Cu** or wafer, **W**, column 4, line 32 and Fig. 12) a dielectric film **710** made of fluorine-added carbon (CF, column 15, line 2 and Fig. 12);
- depositing on the dielectric film a silicon carbide film **810/820** (SiC, column 14, line 67 and Fig. 12) by a plasma (column 15, line 16-26) containing active species of silicon (SiH₄, column 15, line 22) and carbon (C₂H₄ and C₄F₈, column 15, lines 22-23); and
- depositing on the silicon carbide film a thin film **830** (SiCN, column 14, line 67 and Fig. 12) serving as a hardmask made of nitrogen-added silicon carbide by a plasma (column 15, lines 48-60) containing active species of silicon (SiH₄, column 15, line 53), carbon (C₂H₄, column 15, line 42), and nitrogen (N₂, column 15, line 53).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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20. Claims 1-4 and 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Endo in view of Gibson, Jr., et al. (US 2003/0003765 A1, hereinafter "Gibson").

Re claim 1, Endo discloses a manufacturing method of a semiconductor device, comprising the steps of:

- depositing on a substrate **Cu** or wafer, **W**, column 4, line 32 and Fig. 12) a dielectric film **710** made of fluorine-added carbon (CF, column 15, line 2 and Fig. 12); and
- forming on the dielectric film a protective layer **830** (SiCN, column 14, line 67 and Fig. 12) comprising a nitrogen-added silicon carbide film;

Re claim 1, Endo fails to disclose depositing on the protective layer a thin film serving as a hardmask made of oxygen-added silicon carbide by a plasma containing active species of silicon, carbon, and oxygen. Gibson discloses depositing on the protective layer **11** (paragraph 26 and Fig. 2) a thin film **13** (paragraph 26 and Fig. 2) serving as a hardmask made of oxygen-added silicon carbide ("oxygen-doped silicon carbide," paragraph 26) by a plasma (plasma chemistry in PECVD, paragraph 26) containing active species of silicon, carbon, and oxygen (paragraph 26). It would have been obvious to one of ordinary skill in the art at the time the invention was made to add the oxygen-doped silicon carbide of Gibson to the invention of Endo. The motivation to do so is that the combination produces the predictable results of forming an upper barrier layer of oxygen-doped silicon carbide on a lower barrier layer of nitrogen-doped silicon carbide, the layer **13** effective at isolating layer **11** from a subsequently formed low-k dielectric material **17** (paragraphs 7 and 26 and Fig. 2).

Re claim 2, Endo fails to disclose the oxygen-doped silicon carbide, and thus fails to disclose that the plasma containing active species of silicon, carbon, and oxygen is a plasma obtained by activating a gas of an organic silicon compound and an oxygen gas. Gibson discloses that the plasma containing active species of silicon, carbon, and oxygen is a plasma obtained by activating a gas of an organic silicon compound (tetramethyl-silane, paragraph 26) and an oxygen gas (carbon dioxide, paragraph 26). It would have been obvious to one of ordinary skill in the art at the time the invention was made to add the oxygen-doped silicon carbide and its methods of formation of Gibson to the invention of Endo. The motivation to do so is that the combination produces the predictable results of forming an upper barrier layer of oxygen-doped silicon carbide on a lower barrier layer of nitrogen-doped silicon carbide, the layer **13** effective at isolating layer **11** from a subsequently formed low-k dielectric material **17** (paragraphs 7 and 26 and Fig. 2).

Re claim 3, Endo further discloses that the step of forming the protective layer includes the sub-steps of:

- depositing on the dielectric film a silicon carbide film **810/820** (SiC, column 14, line 67 and Fig. 12) by a plasma containing active species of silicon (SiH₄, column 15, line 33) and carbon (C₂H₄, column 15, line 33); and
- depositing on the silicon carbide film a nitrogen-added silicon carbide film **830** (SiCN, column 14, line 67 and Fig. 12) by a plasma containing active species of silicon, carbon, and nitrogen (SiH₄, C₂H₄, and N₂, column 15, line 43).

Re claim 4, Endo further discloses that the step of forming the protective layer includes the sub-steps of:

- depositing on the dielectric film a silicon carbide film **810/820** (SiC, column 14, line 67 and Fig. 12) by a plasma obtained by activating a gas of a silicon compound (SiH₄, column 15, line 33); and
- depositing on the silicon carbide film a nitrogen-added silicon carbide film **830** (SiCN, column 14, line 67 and Fig. 12) by a plasma containing active species of an organic silicon compound (SiH₄, column 15, line 43) and active species of nitrogen (N₂, column 15, line 43).

Re claim 4, Endo fails to further disclose that the silicon compound is an organic silicon compound. Gibson discloses silicon compounds that are organic (tetra-methyl-silane, paragraph 26). It would have been obvious to one of ordinary skill in the art at the time the invention was made to add the organic silicon of Gibson to the invention of Endo. The motivation to do so is that the combination produces the predictable results of forming the silicon carbide and nitrogen-added silicon carbide films with a material that is effective at forming a barrier film (paragraph 7).

Re claim 4, the Applicant has not disclosed that the claimed material (organic silicon) is for a particular unobvious purpose, produces an unexpected result, or is otherwise critical, which are criteria that have been held to be necessary for material limitations to be prima facie unobvious. The claimed material is considered to be a "preferred" or "optimum" material out of a plurality of well known materials that a person of ordinary skill in the art at the time the invention was made would have found obvious

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to provide to the invention of the cited prior art reference, using routine experimentation and optimization of the invention. *In re Leshin*, 125 USPQ 416 (CCPA 1960).

Any differences in the claimed invention and the prior art may be expected to result in some differences in properties. The issue is whether the properties differ to such an extent that the difference is really unexpected. *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Appellants have the burden of explaining the data in any declaration they proffer as evidence of non-obviousness. *Ex parte Ishizaka*, 24 USPQ2d 1621, 1624 (Bd. Pat. App. & Inter. 1992). An Affidavit or declaration under 37 CFR 1.132 must compare the claimed subject matter with the closest prior art to be effective to rebut a prima facie case of obviousness. *In re Burckel*, 592 F.2d 1175, 201 USPQ 67 (CCPA 1979).

Re claims 7-8, Endo discloses the limitations of claim 6, as discussed above, and further discloses that the plasma containing active species of silicon and carbon is a plasma obtained by activating a gas of a silicon compound (column 17, lines) (claim 7) and that the plasma containing active species of silicon, carbon, and nitrogen is a plasma obtained by activating a gas of a silicon compound and a nitrogen gas (column 17, line) (claim 8). However, Endo fails to further disclose that the silicon compound is an organic silicon compound. Gibson discloses silicon compounds that are organic (tetra-methyl-silane, paragraph 26). It would have been obvious to one of ordinary skill in the art at the time the invention was made to add the organic silicon of Gibson to the invention of Endo. The motivation to do so is that the combination produces the

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predictable results of forming the silicon carbide and nitrogen-added silicon carbide films with a material that is effective at forming a barrier film (paragraph 7).

Re claims 7-8, the Applicant has not disclosed that the claimed material (organic silicon) is for a particular unobvious purpose, produces an unexpected result, or is otherwise critical, which are criteria that have been held to be necessary for material limitations to be prima facie unobvious. The claimed material is considered to be a "preferred" or "optimum" material out of a plurality of well known materials that a person of ordinary skill in the art at the time the invention was made would have found obvious to provide to the invention of the cited prior art reference, using routine experimentation and optimization of the invention. In re Leshin, 125 USPQ 416 (CCPA 1960).

Any differences in the claimed invention and the prior art may be expected to result in some differences in properties. The issue is whether the properties differ to such an extent that the difference is really unexpected. *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Appellants have the burden of explaining the data in any declaration they proffer as evidence of non-obviousness. *Ex parte Ishizaka*, 24 USPQ2d 1621, 1624 (Bd. Pat. App. & Inter. 1992). An Affidavit or declaration under 37 CFR 1.132 must compare the claimed subject matter with the closest prior art to be effective to rebut a prima facie case of obviousness. *In re Burckel*, 592 F.2d 1175, 201 USPQ 67 (CCPA 1979).

21. Claims 1 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Endo in view of Wetzel et al. (US 7,199,046 B2, hereinafter "Wetzel").

Re claim 1, Endo discloses a manufacturing method of a semiconductor device, comprising the steps of:

- depositing on a substrate **Cu** or wafer, **W**, column 4, line 32 and Fig. 12) a dielectric film **710** made of fluorine-added carbon (CF, column 15, line 2 and Fig. 12); and
- forming on the dielectric film a protective layer **830** (SiCN, column 14, line 67 and Fig. 12) comprising a nitrogen-added silicon carbide film;

Re claim 1, Endo fails to disclose depositing on the protective layer a thin film serving as a hardmask made of oxygen-added silicon carbide by a plasma containing active species of silicon, carbon, and oxygen. Wetzel discloses depositing on the protective layer a thin film **135** (column 5, lines 42-43) serving as a hardmask made of oxygen-added silicon carbide (silicon oxycarbide, column 5, lines 44-45) by a plasma (PECVD, column 5, line 49). Re claim 1, Wetzel does not disclose that the plasma in PECVD contains active species of silicon, carbon, and oxygen, but it would have been obvious to one of ordinary skill in the art at the time of invention to use a plasma containing active species of silicon, carbon, and oxygen to form a silicon oxycarbide film, with the motivation to do so being that each of silicon, carbon, and oxygen are needed to form a silicon oxycarbide film.

Re claim 5, Gibson and Wetzel disclose the limitations of claim 1, as discussed above, and Gibson further discloses the etching of the dielectric layer, but fails to specifically disclose

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- forming on the thin film serving as a hardmask a resist film having a specific pattern;
- etching the thin film by a plasma through the resist film to obtain a hardmask having a pattern corresponding to that of the resist film; and
- etching the dielectric film by a plasma through the hardmask.

Wetzel discloses

- forming on the thin film **135** serving as a hardmask a resist film **145** (column 6, line 15-16 and Fig. 1A) having a specific pattern;
- etching the thin film by a plasma through the resist film to obtain a hardmask having a pattern (column 6, line 40 and Fig. 1B) corresponding to that of the resist film; and
- etching the dielectric film by a plasma through the hardmask (column 7, line 53-54 and Fig. 1G).

22. Claims 9-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsubara et al. (US 6,149,730, hereinafter "Matsubara") in view of Wetzel.

Re claim 9, Matsubara discloses a film deposition system comprising:

- a first processing vessel (column 2, lines 31-32; column 4, lines 7-18; and Fig. 6) that receives a substrate ("silicon wafer" column 2, line 38 and column 7, line 1);

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- first means (comprising at least “power source **608**”, column 2, line 49) that generates in the first processing vessel a first plasma containing active species of carbon and fluorine (column 7, lines 10-15);
- a second processing vessel that receives the substrate (can be the same as or different than the first processing vessel, see column 4, lines 7-18 and lines 52-58);
- second means that forms in the second processing vessel an atmosphere for depositing a nitrogen-added silicon carbide film (column 7, lines 38-39, wherein silicon, nitrogen, and carbon may be added; any one of these is part of an atmosphere for depositing nitrogen-added silicon carbide);
- a third processing vessel that receives the substrate (can be the same as or different than the first vessel, see column 4, lines 7-18 and lines 52-58);
- third means that generates in the third processing vessel a second plasma (column 7, lines 38-39); and
- a controller (the power sources **101**, **601**, and **608** control the plasma creation in the first, second, and third means; alternatively, the disclosure of Matsubara does not disclose any computer controller that operates the gate valves, gas supplies, the power supply, etc., though such computer controllers are well known in the art and would have been obvious to add to the invention of Matsubara; alternatively, a person manually controlling the apparatus- turning the gate valve, or gas valves on the gas supplies, or turning the power supplies on and off, are also well known in the art and

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would also have been obvious to add to the invention) that controls the first, second, and third means to execute the steps of (the examiner notes that the claim only requires “a controller... to execute the steps”, but does not specify that the steps are executed; thus, merely having one or multiple means to supply the gases or form the plasmas, either in part or in whole, will read on the claim; no films need be disclosed as being formed):

- (a) generating in the first processing vessel the first plasma by the first means to deposit on the substrate a dielectric film made of fluorine-added carbon (“amorphous carbon fluoride”, column 2, lines 31-33 and column 7, lines 10-17);
- (b) forming in the second processing vessel the atmosphere (column 7, lines 38-39, wherein silicon, nitrogen, and carbon may be added; any one of these is part of an atmosphere for depositing nitrogen-added silicon carbide) by the second means to deposit on the dielectric film a protective layer comprising a nitrogen-added silicon carbide film; and
- (c) generating in the third processing vessel the second plasma (column 7, lines 10-21) by the third means to deposit on the protective layer a thin film serving as a hardmask made of oxygen-added silicon carbide.

Re claims 9, as the examiner has noted above, the claim language does not appear to actually require forming the films, but it will be discussed anyhow for

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completeness. Matsubara fails to disclose the “second plasma containing active species of silicon, carbon, and oxygen” and forming a thin film serving as a hardmask made of oxygen-added silicon carbide film; Matsubara also fails to disclose forming a protective layer comprising a nitrogen-added silicon carbide film.

Wetzel discloses forming an oxygen-added silicon carbide film **135** and a nitrogen-added silicon carbide film **115**.

It would have been obvious to one of ordinary skill in the art at the time of invention to use the apparatus of Matsubara, which can combine silicon, oxygen, carbon, and nitrogen, as desired, to form the CF film of Matsubara and the films of Wetzel, in the manner of the claimed combination. The motivation to do so is that the films **135**, **125**, and **115** of Wetzel act as hard masks, etch stop layers, and capping layers for wiring structures (column 6, lines 15-16 and 40), which are useful in the etching of a through-hole in the wiring of Matsubara (column 1, lines 29-39 and column 1, lines 53-55).

Re claim 10, Matsubara further discloses that a single processing vessel is used as at least two of the first, second, and third processing vessels (column 2, lines 31-32; column 4, lines 7-18; and Fig. 6).

Re claim 11, Matsubara discloses a film deposition system comprising:

- a first processing vessel (column 2, lines 31-32; column 4, lines 7-18; and Fig. 6) that receives a substrate (“silicon wafer” column 2, line 38 and column 7, line 1);

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- first means (comprising at least “power source **608**”, column 2, line 49) that generates in the first processing vessel a first plasma containing active species of carbon and fluorine (“amorphous carbon fluoride”, column 2, lines 31-33 and column 7, lines 10-17);
- a second processing vessel that receives the substrate (can be the same as or different than the first processing vessel, see column 4, lines 7-18 and lines 52-58);
- a first gas supply system that supplies into the second processing vessel a first process gas containing silicon and carbon, while controlling a flow rate of the gas (a gate valve controls whether gas is fed in or not, thus being a finite rate or zero; CF gases and CH gases are fed into the plasma generating room; see column 7, lines 10-14);
- a second gas supply system that supplies into the second processing vessel a second process gas containing nitrogen, while controlling a flow rate of the gas (a gate valve is used to either add gas or not, thus being a finite rate or zero; N₂ or NH₃ are fed into the system; this can occur in the second of two film forming rooms **501** or **502**, see column 7, lines 18-27 and Fig. 5);
- second means that converts the first and second process gasses supplied into the second processing vessel into a plasma (column 7, line 10, wherein a plasma is generated); and
- a controller (the power sources **101**, **601**, and **608** control the plasma creation in the first, second, and third means; alternatively, the disclosure of

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Matsubara does not disclose any computer controller that operates the gate valves, gas supplies, the power supply, etc., though such computer controllers are well known in the art and would have been obvious to add to the invention of Matsubara; alternatively, a person manually controlling the apparatus- turning the gate valve, or gas valves on the gas supplies, or turning the power supplies on and off, are also well known in the art and would also have been obvious to add to the invention) that controls the first and second means, and the first and second gas supply systems to execute the steps of (the examiner notes that the claim only requires “a controller... to execute the steps”, but does not specify that the steps are executed; thus, merely having one or multiple means to supply the gases or form the plasmas, either in part or in whole, will read on the claim; no films need be disclosed as being formed):

- (a) generating in the first processing vessel the first plasma by the first means to deposit on the substrate a dielectric film made of fluorine-added carbon (“amorphous carbon fluoride”, column 2, lines 31-33 and column 7, lines 10-17);
- (b) converting in the second processing vessel the first process gas supplied by the first gas supply system into a plasma (column 7, lines 38-39, wherein silicon, nitrogen, and carbon may be added; any one of these is part of an atmosphere for depositing nitrogen-

added silicon carbide) by the second means to deposit on the dielectric film a silicon carbide film; and

- (c) converting in the second processing vessel the first and second process gases supplied by the first and second gas supply systems into a plasma by the second means to deposit on the silicon carbide film a thin film serving as a hardmask made of nitrogen-added silicon carbide.

Re claims 11, as the examiner has noted above, the claim language does not appear to actually require forming the films, but it will be discussed anyhow for completeness. Matsubara fails to disclose forming a silicon carbide film; Matsubara also fails to disclose forming a protective layer comprising a nitrogen-added silicon carbide thin film.

Wetzel discloses forming an oxygen-added silicon carbide film **135** and a nitrogen-added silicon carbide film **115**.

It would have been obvious to one of ordinary skill in the art at the time of invention to use the apparatus of Matsubara, which can combine silicon, oxygen, carbon, and nitrogen, as desired, to form the CF film of Matsubara and the films of Wetzel, in the manner of the claimed combination. The motivation to do so is that the films **135**, **125**, and **115** of Wetzel act as hard masks, etch stop layers, and capping layers for wiring structures (column 6, lines 15-16 and 40), which are useful in the etching of a through-hole in the wiring of Matsubara (column 1, lines 29-39 and column 1, lines 53-55).

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Re claim 12, Matsubara further discloses that a single processing vessel is used as the first and second processing vessels (can be the same as or different than the first processing vessel, see column 4, lines 7-18 and 52-58 and column 7, lines 36-41).

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

23. Claims 1 and 6 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 3-4 of copending Application No. 12/157795 (hereinafter called ‘795). Although the conflicting claims are not identical, they are not patentably distinct from each other because claims 1-8 are largely identical to the subject matter of claims 3-4. Claim 1 requires forming an oxygen-added silicon carbide film on a nitrogen-added silicon carbide film on a fluorine-

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added carbon film on a substrate. Claim 3 of '795 requires forming a film containing silicon and oxygen (which is explicitly claimed as an oxygen added silicon carbide film in claim 4) on a film containing silicon, carbon, and nitride, on a film of silicon nitride, on a fluorine-added carbon film, on a substrate. It would have been obvious to one of ordinary skill in the art at the time of invention that a "film containing silicon, carbon, and nitride" is an obvious wording of "nitrogen-added silicon carbide", and that these phrases contain the same limitation. The claims each require "active species" of the constituent gases. Claim 6 requires forming a nitrogen-added silicon carbide film on a silicon carbide film on a fluorine-added carbon film on a substrate.

24. Since claims 1 and 6 each contain the limitations of copending claims 3-4 of '795, each with one step/film of '795 missing, then claims 1 and 6 are obvious over claims 3-4 of '795.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Conclusion

25. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kevin Parendo, whose can be contacted by phone at (571) 270-5030 or directly by fax at (571) 270-6030. The examiner can normally be reached on Mon.-Thurs. and alternate Fridays from 7 a.m. - 4:30 p.m. EST.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith, can be reached on (571) 272-1907. The fax number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Kevin A. Parendo/
Examiner, Art Unit 2823
1/28/2009

/Hsien-ming Lee/

Primary Examiner, Art Unit 2823